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FROM THE

MASSACHUSETTS HISTORICAL SOCIETY.

Ordnance.

Shall a Cast-Iron Rifled Gun be Tested?

F. F. S.
COLONEL LAIDLEY.

F. G. D.
June 24, 18

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Shall a Cast-Iron Rifled Gun be Tested?

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A STATEMENT

OF REASONS FOR BELIEVING THAT

A CHEAPER AND STRONGER GUN

CAN BE MADE OF

CAST-IRON

THAN BY THE

COMBINATION OF WROUGHT-IRON AND CAST-IRON

Adopted by the Ordnance Department

IN ITS RECENT CONSTRUCTIONS.

BY

T. T. S. LAIDLEY,

COLONEL OF ORDNANCE.

BOSTON:
ALFRED MUDGE & SON, PRINTERS,
34 SCHOOL STREET.
1881.

War 4298.81.3

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Mar 28, 1939.

WATERTOWN ARSENAL, July 14, 1881.

TO THE PRESIDENT OF THE BOARD ON HEAVY ORDNANCE, *New York City:*

SIR, — I have the honor respectfully to submit for your consideration, together with my reasons therefor, the proposition to recommend as "worthy of actual test" the following named guns: —

First. An 8-inch cast-iron, rifled gun, represented in Fig. 1, and cast as described on page 15.

Second. An 8-inch cast-iron, rifled gun, Fig. 2, lined with a thin bronze tube.

Third. An 8-inch cast-iron, rifled gun, breech-loading, Fig. 3, and further described on page 16.

It will be observed that these guns are all cast-iron guns, depending solely upon this material for their strength, except only the breech-loader, which is reinforced at the breech by a supplementary steel band.

It may be regarded by some of the members of the Board an already settled question, as claimed by some, that cast-iron guns require to be strengthened before they can safely be subjected to the strains which they have to withstand as rifled guns, and I shall therefore endeavor to show that this assertion, if true, has never been proved to be true, but on the contrary there are strong reasons for believing that it is entirely without foundation in fact.

The Ordnance Board of 1868, in giving its opinion on this subject, said, "The success of the experiments with the 12-inch cast-iron rifle at Fort Monroe, evidently demonstrates that further trials with cast-iron, recommended by the Chief of Ordnance, in his annual report, for 1867, should be made."

The Board, which met in New York in 1872 to designate what heavy guns should be tested, expressed the opinion that experiments should be continued by the Ordnance Department, "with the view to obtaining such uniformity of pressures

as shall render admissible the use of cast-iron in heavy ordnance construction." The Board evidently did not regard it at that time as an established fact that cast-iron would not answer for heavy rifled guns, and it must be borne in mind that no experiments have been made bearing on this question since that time. The Board was of opinion that, as soon as our powder and projectiles had been so improved as to give uniform results, cast-iron would be available as a material for heavy guns. Gen. Rodman had expressed to a committee of Congress the same opinion, and in 1873 the Chief of Ordnance, Gen. Dyer, in his annual report, recommended, "in the spirit of judicious economy," an appropriation of $75,000 for the manufacture and trial of cast-iron 12-inch rifled guns. He gave in full the reasons for this recommendation, viz., that the improvements made in both projectiles and powder had been such that the former would offer a uniform resistance to the pressure of the powder, which in its turn gave "increased initial velocity with marked diminution of pressure."

As Chief of Ordnance, he must of necessity have known whether the results of experiments had already proved that cast-iron was not strong enough to resist the strains, and on this account would not answer for heavy rifled guns; that he did not know of any such experiments is clear from the fact that he said that "this recommendation is made in the spirit of judicious economy."

We have then the concurrent opinions of the Ordnance Board of 1868, approved by the Chief of Ordnance, the Board on Heavy Ordnance in 1872, Gen. Rodman, and the Chief of Ordnance again in his report of 1873, that the question of the fitness of cast-iron for heavy rifles was not at *that* time determined, but was an open one, requiring further experiments; and as no tests have been since made, it follows that the question is still an open one, not definitely settled, but remaining to be solved by further trials.

I shall now proceed to show that the weight of evidence, from the endurance of cast-iron guns which have been tested, is in favor of this material as a suitable one for rifled guns of at least 8 inches bore, and to bring together a portion of this evidence, that you may impartially weigh it, and judge whether

it be sufficient to warrant further trials being made with rifled guns constructed solely of this metal.

But what are the enormous strains that heavy rifled guns have to resist? When rifled guns of large calibre first began to be used, the quick powder and imperfect projectiles at that time used developed such enormous strains that it came to be generally believed that rifled guns were necessarily subjected to far greater strains than smooth-bore guns of the same size, and this opinion continued to obtain for many years thereafter. Even within a few years back, when the 10-inch converted gun blew out a large portion of the lining tube, tearing off with it the muzzle of the gun, it was accounted for by some by what was called the drag of the projectile passing through the bore. This opinion has, of course, ceased to be entertained.

Prof. Bartlett and others have investigated thoroughly the strains brought on rifled guns, and it is now a well-established fact that these strains are only slightly greater than those borne by the smooth-bore gun. The 8-inch rifle projectile leaves the bore with only forty-eight feet less velocity, as calculated by Bartlett's formula, than would be communicated to the same projectile if it had no rotary motion. Powder and projectiles have been so improved that the action of each is as regular and uniform in the rifled gun as in the smooth-bore; and as remarked by Prof. Bartlett, the failure of rifled guns must be sought in some other cause than the superaddition of the pulling and twisting strains to that which acts to split the piece; and so far as the principles of rifling are concerned, these guns may be made as safe as the common smooth-bores. The report of the Chief of Ordnance, 1878, page 425, gives the pressures on the bore obtained in the trials of three 8-inch converted guns, the endurance of which is regarded as so highly satisfactory that the Chief of Ordnance, speaking of it, says, "Our success has been so consistent, so thorough, so complete, that we consider it an admirable system of gun construction." One gun endured a mean recorded strain of 26,462 pounds per square inch, from 710 rounds; another stood the same strain, from 776 rounds; and a third was subjected to a mean recorded pressure of 27,189 pounds per square inch, from 590 rounds.

The gun first mentioned was not required to bear a single strain as great as 29,000 pounds per square inch; the next endured three strains greater than 40,000 pounds, the greatest being 43,000 pounds, fifteen of 35,000 pounds or more, and three hundred and twenty-two of 30,000 pounds or more. The other, fired only five hundred and ninety times, bore strains of 30,000 pounds or more, fifty-six times; 35,000 pounds or more, thirty-four times; 40,000 or more, nine times; 50,000 pounds or more, four times; and one strain of 56,000 pounds per square inch. The length of the cartridge was twenty-two inches, and the area of the bore in rear of the projectile five hundred and ninety-five square inches, making the aggregate strain endured by this last gun 16,177,455 pounds, repeated five hundred and ninety times.

Will an 8-inch rifled gun, made of cast-iron, endure these strains this number of times?

This question is best answered by showing what cast-iron guns of this size have done. Only two cast-iron 8-inch rifled guns have been tested by firing with expanding projectiles. The record of the first I have been able to obtain only this far, that it was fired at Fort Monroe in 1864; it burst at the 1,047th fire, and of the last *eighty rounds* the pressures were as follows: —

1	round,	the	pressure	was	less	than	20,000	lbs.	per	square inch.
5	rounds,	the	pressures	were	less	than	27,000	"	"	"
52	"	"	"	"			30,000	" or more	"	"
32	"	"	"	"			40,000	" "	"	"
23	"	"	"	"			50,000	" "	"	"
13	"	"	"	"			70,000	" "	"	"
5	"	"	"	"			90,000	" "	"	"
1	"	"	"	"			150,000	"	"	"

The other gun was fired in 1866, eight hundred and forty-five rounds, sustaining the following pressures: —

28	rounds,	the	pressures	were	less	than	20,000	lbs.	per	square inch.
59	"	"	"	"	"	"	7,000	"	"	"
766	"	"	"	"			30,000	" or more	"	"
449	"	"	"	"			40,000	" "	"	"
222	"	"	"	"			50,000	" "	"	"
111	"	"	"	"			70,000	" "	"	"
13	"	"	"	"			125,000	" "	"	"
12	"	"	"	"			150,000	" "	"	"

This gun has since been fired nineteen times, making in all eight hundred and sixty-four rounds, and is still sound.

The charge of powder was in most cases fifteen pounds, occupying twelve inches of the bore, or an area of three hundred square inches.

Here we have two cast-iron guns which have been fired a greater number of times and with greater strains per square inch of the bore pressed than either of the converted guns.

What the equivalent of a pressure of 150,000 pounds per square inch may be in terms of pressures of 27,000 pounds no one will pretend to be able to say. The only experiments which have been made on this subject show that a slight reduction in the strain adds very greatly to the number of times that it may be repeated. Thus a specimen of cast-iron, subjected to a strain of 30,000 pounds per square inch, endured this strain one hundred and twenty-five times, and its duplicate endured a strain of 27,000 pounds two hundred and fifty times. From this it would be fair to infer that twelve strains of 150,000 pounds per square inch would be equivalent to many hundreds of only 27,000 pounds.

Although these two are the only rifled cast-iron guns which have been tested by firing expanding projectiles, several smooth-bore guns of the same exterior size have been fired from time to time, and a consideration of their endurance will be instructive, and can hardly fail to give us a greater respect for cast-iron as a material to be used in the construction of heavy ordnance.

The first to which I shall invite your attention is 10-inch gun No. 2, W. P. F., 1846, a chambered gun of imperfect model. It was fired, —

100	rounds,	with	18	lbs.	of	powder,	and	1	solid	shot.
1	round,	"	"	"	"	"	"	2	"	"
1	"	"	"	"	"	"	"	3	"	"
1	"	"	"	"	"	"	"	4	"	"
1	"	"	"	"	"	"	"	5	"	"
1	"	"	"	"	"	"	"	6	"	"
1	"	"	"	"	"	"	"	7	"	"
1	"	"	"	"	"	"	"	8	"	"
1	"	"	"	"	"	"	"	9	"	"
1	"	"	36	"	"	"	"	9	"	"

It must be remembered that this powder was what is known as mortar-powder, and gave a strain with a single shot of over 70,000 pounds per square inch. What the strains were with the other charges can only be conjectured, but it is perfectly clear that they must have been very much more violent than any that modern rifled guns are ever made to bear; and that this gun should have endured the last charge of 36 pounds of quick powder and 1,130 pounds of shot without bursting, after having previously endured a number of enormous strains, shows that *this* cast-iron gun at least was not deficient in strength.

The next which I shall bring to your notice are 10-inch Rodman guns, Nos. 362 and 363, F. P. F., one cast solid and the other hollow. These guns I fired in 1858, 2,450 times each. They were afterwards fired by Capt. Dyer, at Fort Monroe, 1,632 rounds more, making in all 4,082 times each, besides the proof-rounds, with the following charges: —

2,396	rounds,	with	14	lbs.	of	mortar-powder,	1	shot	and	sabot.
12	"	"	15	"	"	"	"	"	"	"
14	"	"	16	"	"	"	"	"	"	"
15	"	"	17	"	"	"	"	"	"	"
1,645	"	"	18	"	"	"	"	"	"	"
1	"	"	20	"	"	"	"	and wad.		
1	"	"	24	"	"	"	"	1 shell, sabot and wad.		

The guns are still unbroken. The pressures with 18 pounds of powder, when the guns were new, were 71,950 pounds per square inch, and at the close of the firing 39,793 pounds per square inch.

If we multiply the area of the bore in rear of the shot by the maximum strain per square inch, we find that these two guns for 1,600 rounds resisted a greater aggregate of strains each round than any of the converted guns, and in several instances nearly twice as much.

Here, then, we have two more cast-iron guns which have shown themselves not only capable of enduring greater strain than the converted guns are subject to, but also of resisting the molecular disturbance caused by firing 4,082 rounds.

The next 10-inch gun which was fired repeatedly with high charges was No. 1442, S. B. F., 1863. It was fired, —

1,000	rounds	with	15	lbs.	cannon	powder	and	1	solid	shot or shell.*
100	"	"	20	"	"	"	and	solid	shot.	
100	"	"	25	"	"	"	"	"	"	
100	"	"	30	"	"	"	"	"	"	
100	"	"	30	"	quick	"	"	"	"	

The pressures were with				25	lbs.	of cannon	powder	39,225	lbs.	per	square inch.
"	"	"	"	30	"	"	"	54,000	"	"	"
"	"	"	"	30	"	quick	"	64,900	"	"	"

The last 10-inch gun which was tested is No. 542, S. McM. & Co. This gun was supposed to be defective from having too great an initial strain in cooling. It was fired: —

18	rounds,	with	18	lbs.	powder,	and	shot	of	127	lbs.
17	"	"	20	"	"	"	"	"	"	"
2	"	"	22	"	"	"	"	"	"	"
456	"	"	25	"	"	"	"	"	"	"
125	"	"	26	"	"	"	"	"	"	"
4	"	"	27	"	"	"	"	"	"	"
1	round,	"	28	"	"	"	"	"	"	"
8	rounds,	"	30	"	"	"	"	"	"	"
11	"	"	32	"	"	"	"	"	"	"
3	"	"	35	"	Oriental	powder	No. 5,	and	shot	of 127 lbs.
645	Total.									

The pressures were as follows: —

18	rounds,	20,000	to	30,000	lbs.	per	square	inch.
17	"	22,000	to	60,000	"	"	"	"
2	"	23,000	to	26,000	"	"	"	"
456	"	22,000	to	65,000	"	"	"	"
125	"	21,000	to	72,000	"	"	"	"
4	"	33,000	to	51,000	"	"	"	"
1	round,			54,000	"	"	"	"
8	rounds,	26,000	to	100,000	"	"	"	"
11	"	19,000	to	58,000	"	"	"	"
3	"	10,000	to	18,000	"	"	"	"

In estimating the work done by the gun at each discharge, it has been assumed that the part of the bore subjected to the maximum strain is that in rear of the shot at the moment of discharge, but the experiments of Noble and Abel show that with pebble powder the shot has moved about six inches from its seat at the time the strain has reached its maximum. No experiments have been made in this country, that I am aware of, to determine this point for our powders. In the smaller

* One fifth were solid shot, the rest shells.

grained powders with which the guns just considered were fired, the shot, though lighter, did not probably move as far as in the converted guns, and on this account the amount of work done would have to be corrected somewhat, but to what extent we have not the necessary information to determine.

These experiments show what are the capabilities of cast-iron as a material for guns; what it has done, and what it can be made to do. With such facts before the mind, it seems strange that any one can be found who doubts the reliability of cast-iron for rifled guns of at least eight inches bore. It was the careful study of this demonstration of the ability of cast-iron to resist enormous strains often repeated (results not generally known by officers), and an intelligent appreciation of their bearing and weight, that led Gen. Rodman to express the opinion that "after we shall have procured a projectile that is as certain in its operation in the rifled gun as the round shot is in the smooth-bore, we can, by firing to extremity one or two 12-inch rifles, fix a limit within which the gun may be considered as absolutely safe." I, for one, am of the opinion that the conclusion is abundantly warranted by the facts.

But we, at this present time, are not required to decide the question of the fitness of cast-iron for rifled guns solely on the evidence which has been just adduced. Within the last year or two other experiments have been made having an intimate bearing on this subject, throwing much light on it, and rendering it far easier of a definite solution. To these I shall now briefly allude.

In 1878, I induced the board for testing iron, steel, and other metals to grant me an appropriation of $1,000 to make experiments on the resistance to internal strains of thick cast-iron cylinders, some of which were to be lined with wrought-iron or bronze tubes. These experiments were not completed until September last, and proved conclusively that the cylinder was weaker in proportion as it was cut away to make room for the lining tube.

Cast-iron cylinders eleven inches in diameter and twenty-two inches long were bored out to a diameter of 3.″3, filled with beeswax to a depth of 10″, and a pressure applied to a closely fitting piston until the cylinder was burst. Similar cylinders

were bored out to receive a lining of wrought-iron formed of the same metal and in the same manner as the wrought-iron tubes used in the conversion of 10″ guns, the interior diameter of the lining being the same as the first-mentioned cylinders. The circumstances of the trials were the same as nearly as possible in both cases, and the strength of the cast-iron cylinders was found to be about eighteen per cent greater than those lined with wrought-iron. Experiments were also made to test the effect of continuing the bore through the breech and afterwards closing it with a screw-plug. These last cylinders were found to have about five per cent less strength than that with a solid breech.

These experiments show that since a new and better gun can be made for a less sum than that paid for the conversion of the old gun, it was an error to convert any of the latter; but such conversion having been determined upon, it was an error to enlarge the bore at all with the view to increasing the thickness of the wrought-iron lining; and it further diminished the strength to continue the bore through the breech in order to insert the lining from the rear. It was also an error to make the tube in two parts, thereby still further decreasing its transverse resistance.

Gen. Rodman has proved beyond a doubt that the sudden strain exerted by inflamed gunpowder does not partake of the nature of a blow, but is a pressure quickly applied and as quickly relieved; it differs from the pressure exerted by the testing machine only in the rate of application and release of the strain. The effect of this rapid application has been carefully considered by both Mallet and Rodman, and the conclusion reached is, "that the excessive strain upon the gun above that due to statical pressure, caused by the most rapid rate of application or development of that pressure, is a very small percentage of the total strain." Gen. Rodman based his whole system of gun construction upon the results obtained by the testing machine, and, so far as I am aware, the correctness of his conclusions has never been questioned. So too, Col. (now Gen.) Rosset, of the Italian army, has based his present system of guns, in which the combination of wrought and cast iron has been rejected, on the results obtained by the testing machine.

It has been urged with great confidence by some that the results obtained by these experiments are in direct conflict with certain gunpowder tests made by Sir Joseph Whitworth, which are regarded as conclusive in proving that cast-iron guns are not as strong as similar guns lined with wrought-iron tubes.

The account of these experiments as given by Sir Joseph himself shows that they were undertaken to prove the superiority of his compressed steel over wrought-iron, cast-iron lined with wrought-iron, and in fact all other materials for guns. He took a cylinder made of cast-iron "which I (he) knew to be of good quality," 26 inches long, 7.83 inches in diameter, and a bore of 2.56 inches. The ends were closed with steel plungers, after having introduced three ounces of powder, and secured by steel caps screwed on. The cylinder burst into twenty pieces. He adds: "I have also had a cylinder made of cast-iron, with a coiled wrought-iron tube inside to represent the proportions adopted in the conversion of old 8-inch smooth-bore guns into rifled 64-pounders. The inner diameter or bore was 2.56 inches; the thickness of the wrought-iron tube, 0.690 inches; and the outside diameter, 7 83 inches. The area of cast-iron was not sufficient to support the end strain, and the caps were held together by additional screws fitted into an external casing. Four charges were fired, the weight of powder being 5, 6, 8, and 10 ounces respectively. The enlargement of the cylinder after the discharge of 8 ounces was 0.0317 inches on the inside, and 0.0017 inches on the outside. The fourth discharge of only 10 ounces broke the cylinder into fragments, viz., of cast-iron *one hundred and seventy-four*, and of wrought-iron seven pieces."

It is to be borne in mind that these experiments were not made for the purpose of comparing cast-iron guns with similar ones lined with wrought-iron: the cast-iron in the two cases was not identical; it was not gun-iron, and therefore the comparative strength of the two cylinders proves nothing as to the strength of *guns* lined and not lined with wrought-iron. That the iron was not gun-iron is evident from several considerations. In the first place it is not spoken of as anything more than "good iron." How good it was, what was its tensile

strength, its density, elasticity, or extensibility, is not stated, and was not probably known.' An iron which will stand 12,000 pounds per square inch is in England considered a good iron, but we do not think of making guns of such metal; for this purpose only the best, cold-blast, charcoal iron, melted in an air furnace, and having a tensile strength of 30,000 pounds per square inch as the minimum, with a good extensibility and elasticity, is ever thought of as a proper gun-iron.

The very fact that three ounces of powder burst a cylinder of 2.56 inches bore and 2.5 inches thickness, shows conclusively that the iron was not gun-iron, and the additional fact that ten ounces of powder burst a similar cylinder 1.945 inches thick, with a wrought-iron lining 0."69 thick, into *one hundred and seventy-four fragments*, is incontestable proof that this was not such an iron as guns are made of.

It is further to be observed that the two cylinders were not tested under the same circumstances. The lined cylinder was entirely relieved from all longitudinal strains, for "the caps were held together by additional screws fitted into an external casing." That this arrangement enabled the lined cylinder to offer greater resistance there can be no doubt, but to what extent it is difficult to estimate.

That any logical conclusions conflicting with the results obtained from my experiments on cylinders can be drawn from Sir Joseph's powder tests, just described, is so evidently impossible that further remark is unnecessary.

If, however, in place of my deductions, based on these trials, you should prefer to have the results of direct experiments, I am glad to be able to lay such results before you, for I have recently had the satisfaction of witnessing some carefully conducted experiments made by Capt. John G. Butler, Ordnance Department, wherein he proposed to repeat Whitworth's powder test of iron cylinders, using our gun-iron of known good quality. Two cylinders were cast from the same ladleful of metal, turned to the same exterior dimensions, and bored out the same as Whitworth's, and one of them lined with a wrought-iron tube of the best quality. These were fired with 3, 4, 6, and 10 ounces of powder taken from the same barrel. After resisting the 8-ounce charge, the simple cast-iron cylinder

showed no increase in the exterior diameter, the lined one was enlarged 0.″008. The bore of the former had enlarged 0.″015, the latter 0.″052; and it is plain that the lined cylinder was nearer the point of rupture than the other. The charges of 10-ounce, which increased the strain more than twenty-five per cent, ruptured both cylinders, the cast-iron of each breaking into twenty-six pieces, and the tube into seven pieces additional.

This powder test, then, confirms the results of the experiments made with the testing machine, and extinguishes forever the unsupported claim of the superior strength of the lined cylinder.

I have still one more fact which I wish to lay before you, before closing my argument in favor of the superior strength of cast-iron guns over those lined with wrought-iron tubes: it is the result of an experiment made with gunpowder, and it seems to me to be conclusive on this subject.

Finding that there was no prospect of the Ordnance Department authorizing any experiments to show whether gunpowder would confirm or disprove the verdict of the testing machine in regard to the strength of cast-iron guns, and regarding the question as one of great importance to the country, I proceeded to procure on my own account two cast-iron guns representing accurately in exterior model the 10-inch Rodman guns to a scale of four tenths ($\frac{4}{10}$) the full size, and to line one of them with a coiled wrought-iron tube made in the same way and of the same metal as the tubes used in the conversion of guns; the other was of simple cast-iron. The guns were cast solid from the same ladleful of metal, and were finished without trunnions, and of the same size in every particular as nearly as possible. The model selected was that of the converted eight-inch rifle. The maximum diameter was 12.″8, and that of the bore 3.″2. The weights were 955 and 931½ pounds respectively. The guns were fired under the same circumstances, with charges of two and five tenths pounds of powder and first with a shot weighing twenty-two pounds, second with one of thirty and a quarter pounds, and afterwards with two shot of the last-named weight. The cast-iron gun proved superior to the lined gun in about the same proportion as had been found by the experiments with statical pressures, and we have the verdict of

superior strength of the cast-iron gun over that of cast-iron lined with a wrought-iron tube, pronounced in the first place by the testing machine, now confirmed by actual trial with gunpowder in a gun of 3."2 bore. I have only briefly referred to these trials for the reason that my reports of September 11, 1880, and June 25, 1881, to the Chief of Ordnance, will doubtless be laid before you under the direction to "furnish the Board with all the information on the subject in his possession."

I am of the opinion that it is not advisable to convert the 10-inch smooth-bore guns into rifles. The object of the trials which I here propose is to show that it will be far more economical to make new guns, which shall be in every respect superior to the converted guns, and can be produced at the same or less cost. I propose to make an 8-inch rifle longer and heavier than the converted gun, to cast it breech uppermost, the hollow core passing through the breech, with the view of avoiding the initial strains that are known to exist in guns cast with a solid breech; to fire it to extremity with a proper powder, to be determined by trial, which shall give an initial velocity of 1,290 feet or more, or continue the firing until its superiority shall be conclusively established.

It is well known that cast-iron guns begin to break from the interior, cracks form and the gases entering therein act on a larger area, and finally burst the gun. The extent to which this shortens the life of the gun is not known, and it is proposed to determine it by the gun No. 2, which has a thin tube of bronze lining the bore; the tube may be turned and grooved on its exterior and then inserted in the bore, or the cheaper plan of lining only the chamber may be used.

It is proposed to fire this gun under exactly the same circumstances, with the same charges, etc., as the first, and thus determine the question whether the increased cost is compensated by the greater endurance of the gun.

The Heavy Ordnance Board of 1872 recommended that a breech-loading gun, with the slotted-screw breech similar to that used by the French, Swedes, and Italians, should be tested. No such trial has ever yet been made by the Ordnance Department, and the success which has attained this plan in other countries and our own navy, its greater simplicity and

less cost, compared with the plan adopted, render it highly desirable that a fair trial of its merits should be made.

No. 3 represents such a gun. It will be cast breech uppermost, cooled from the interior, and have a thin band of steel around the breech.

The guns here proposed have received the approval of one of the great gun-founders of the country, who has adopted the first and second, the latter without the supplementary steel band, and recommends them as good models for cast-iron guns.

The vast extent of our sea-coast which calls for protection is so great as to require large rifled guns by the thousand; and the question of what material they shall be constructed becomes one of the greatest importance. We have cast-iron of the best quality, and we understand the manner of treating it in order to make uniformly superior guns of the largest calibre. If these guns will answer as well as those of more expensive construction, it is highly important that we should know it at once. If they shall prove to be superior to those which we are now making, as I believe they will do, and as I think the facts which I have here adduced will warrant us in believing, we cannot have the proof of it too soon.

Gen. Rodman proposed to improve the quality of our cast-iron guns by improving the metal of which they are made, and the best mode of doing this he carefully elaborated; but the present adopted plan of increasing the efficiency of our heavy ordnance discards this plan, and in its place adopts a certain combination of wrought and cast iron, thereby adding greatly to the cost of production, and, according to the results of the experiments just mentioned, diminishing in a marked degree the strength and endurance of the gun. Whether it be advisable to continue the fabrication of large guns on this latter plan without first comparing their endurance with that of cast-iron guns pure and simple, as herein proposed, is a question left to you to decide, with the aid of all the light that can be thrown upon it by the latest experiments, supplemented by such as you may deem it wise to make.

T. T. S. LAIDLEY,

Colonel of Ordnance.

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